Before the
Federal Communication Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of the Commission's	)	ET Docket No. 96-102
Rules to Provide for Unlicensed	)	RM-8648
NII/SUPERNet Operations in the	)	RM-8653
5 GHz Frequency Range	)	

To: The Commission

COMMENTS OF RESOUND CORPORATION

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July 11, 1996

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SUMMARY

ReSound Corporation ("ReSound") hereby submits its comments in response to the Notice of Proposed Rule Making in ET Docket No. 96-102. ReSound is the fourth-largest, and fastest growing, hearing healthcare company in the world, and is a worldwide leader in the development and manufacture of scientifically advanced solutions for the hearing impaired, dispensing audiologist, and pediatric communities.

ReSound has determined that the allocation scheme set forth in the NPRM, if adopted without modification, would significantly harm the $2 billion-a-year hearing aid industry. For technical reasons described in greater detail within, ISM frequencies in the 5 GHz band hold particular promise in offering advanced solutions for the hearing impaired. The proposed sharing of the ISM band -- in particular, the 5.850-5.875 GHz band -- with NII/SUPERNet devices threatens these publicly beneficial healthcare advancements.

With minor modifications, the Commission's proposal could protect the interests of both users and manufacturers of hearing healthcare products as well as achieve the anticipated benefits of NII/SUPERNet devices. The results of ReSound's technical analysis of the proposed NII/SUPERNet allocation indicate that sharing between NII/SUPERNet devices and ISM equipment is possible, provided that (1) NII/SUPERNet devices are not permitted to operate in the 5.850-5.875 GHz band; (2) ISM

equipment continues to be accorded primary status in the 5.725-5.875 GHz band; and (3) NII/SUPERNet devices are limited to 100 milliwatts peak EIRP, as proposed. In addition, ReSound recommends limiting the NII/SUPERNet allocation to 300 MHz at this time.

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ReSound Corporation ("ReSound"), by its attorneys and pursuant to Section 1.415(a) of the Commission's Rules, hereby submits its comments in response to the Notice of Proposed Rule Making (the "NPRM"), FCC 96-193, released May 6, 1996, in the above-captioned proceeding. The following is respectfully shown.

I. Preliminary Statement

1. The NPRM has its genesis in separate requests filed with the Commission in May 1995 by Apple Computer, Inc. ("Apple") and the Wireless Information Networks Forum ("WINForum"), seeking an allocation of spectrum in the 5 GHz frequency band for use by a new category of unlicensed devices. WINForum requested a total of 250 MHz of spectrum (at 5.10-5.35 GHz) for such equipment, which it terms "SUPERNet" (Shared Unlicensed PErsonal Network) devices.[1/]

[1/] Petition for Rulemaking of WINForum, filed May 15, 1995.

Apple requested 300 MHz (at 5.15-5.30 and 5.725-5.875 GHz) to facilitate high-speed wireless access to the National Information Infrastructure ("NII") by unlicensed equipment.[2] Comments filed in response to the Apple and WINForum petitions for rulemaking indicate that the two proposals are compatible and complimentary with one another.[3] The NPRM tentatively concludes that these requests have merit, and proposes to make 350 MHz of spectrum available -- more spectrum in the aggregate than either Apple or WINForum alone requested -- for NII/SUPERNet devices. The Commission seeks comments on issues related to implementing the proposed NII/SUPERNet allocation. One key area of inquiry is the prospect for interference to incumbent users of the designated spectrum.[4]

2. ReSound is the fourth-largest (and one of the fastest growing), hearing healthcare company in the world. ReSound was formed as a spinoff from AT&T and its products use technology developed originally by Bell Laboratories. The company is a worldwide leader in the development and manufacture of scientifically advanced solutions for the hearing impaired, dispensing audiologist, and pediatric communities. Technological innovations and strategic

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[2] Petition for Rulemaking of Apple, filed May 24, 1995.

[3] See NPRM, paras. 9, 17.

[4] See NPRM, paras. 46-54.

acquisitions have spurred the company's growth in recent years, and today ReSound is positioned to provide hearing healthcare products to a wide range of hearing-impaired users, from children to profoundly deaf senior citizens.

3. As is set forth below in detail, ReSound has determined that the allocation scheme set forth in the NPRM, if adopted without modification, would significantly harm the $2 billion-a-year hearing aid industry. Many existing and proposed hearing healthcare products use radio frequencies in the Industrial, Scientific and Medical ("ISM") for auditory enhancement. For technical reasons described in greater detail within, ISM frequencies in the 5 GHz band hold particular promise in offering advanced solutions for the hearing impaired. The proposed sharing of the ISM band with NII/SUPERNet devices threatens these publicly beneficial healthcare advancements. With minor modifications, however, the Commission's proposal could protect the interests of both users and manufacturers of hearing healthcare products as well as achieve the anticipated benefits of NII/SUPERNet devices.

4. The Commission proposes allocating for NII/SUPERNet use the entire 5.725-5.875 GHz band, which currently is allocated for ISM devices, including hearing aids and other hearing healthcare products. The NPRM purports to be adopting rules to ensure that NII/SUPERNet devices do not cause harmful interference to incumbent and

proposed ISM operations.[5] The proposals set forth in the NPRM for sharing between unlicensed NII/SUPERNet devices and ISM devices may succeed in preventing interference within most of the ISM band, but not in the 5.850-5.875 GHz band. This limited portion of the ISM band -- which ReSound refers to hereafter as "the Quiet Band" -- is subject to much lower permissive power levels than the remainder of the band.[6] As a result, low-powered devices operating in the Quiet Band will receive interference from NII/SUPERNet devices, and this interference will not be avoided by the Spectrum Etiquette for NII/SUPERNet that is offered. Consequently, ReSound's principal concern with the NPRM's proposed allocation is the inclusion of the 5.850-5.875 GHz band, and ReSound urges the Commission not to allocate this portion of the 5 GHz ISM band for NII/SUPERNet use.

5. ReSound has carefully reviewed the Commission's proposals, and includes with its Comments a Technical Statement, entitled Prospects for Interference to Permissible Operations in the 5.850-5.875 GHz Band Caused by Unlicensed NII/SUPERNet Operations, which represents the collective efforts of ReSound's scientists, technical personnel, and consultants. See Exhibit 1. The Technical

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[5] NPRM, para. 46.

[6] Specifically, in other portions of the band (5.725 GHz to 5.850 GHz) ISM devices must co-exist with unlicensed spread spectrum devices operating with up to 1 watt of power. Compare Sections 15.247 and 15.249 of the rules.

Statement concludes that the proposed NII/SUPERNet allocation is incompatible with existing and proposed operations by ISM equipment in the 5.850-5.875 GHz band, and recommends deleting the Quiet Band from the proposed NII/SUPERNet allocation.

II. ISM Devices Merit Special Consideration in Any Spectrum Allocation Decision Affecting the 5 GHz Band

A. Unique Characteristics of the 5.725-5.875 GHz Band

6. The Commission has recognized the public interest benefits resulting from its allocation of spectrum for use by ISM equipment.[7] In setting aside spectrum in eleven frequency bands -- including the 5.725-5.875 GHz band -- for ISM equipment, the Commission decided not to impose emission restrictions, and required radio services that share the ISM bands with ISM equipment to operate on a secondary basis.[8]

7. The Commission's foresight in allocating spectrum for ISM equipment has greatly benefited millions of hearing-disabled Americans. Some 6 million Americans suffer from hearing disabilities that require hearing aids, and another 20 million individuals are believed to have

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[7] The Commission defines ISM equipment as "equipment or appliances designed to generate and use radio frequency (RF) energy to perform some work other than telecommunications." 47 C.F.R. § 18.107(c).

[8] 47 C.F.R. § 15.247, Note.

experienced some degree of hearing loss, but choose not to obtain medical assistance. The Commission's rules play a critical role in serving the needs of the hearing impaired by according primary status to ISM devices, including hearing aids, thereby making interference-free operation possible and improving the lives of a large and growing segment of the population.[9/]

8. The Commission's rules provide particularly stringent interference protection to ISM devices operating in the 5.850-5.875 GHz band. Specifically, unlicensed communications systems operating under section 15.249 of the Commission's rules -- including devices for the hearing-impaired -- presently may operate within the Quiet Band and thereby avoid interference from transmitters that operate under rule section 15.247, which permits higher power operations (on a secondary basis).[10/]

9. The special protection from interference accorded to the Quiet Band makes it the focus of new technological developments for the benefit of persons with hearing disabilities. Until relatively recently, hearing aid devices were large, cumbersome, and unsightly. Many potential users refrained from acquiring hearing aids because of a perceived stigma associated with wearing them.

[9/] 47 C.F.R. § 15.247.

[10/] See 47 C.F.R. § 15.249; OET Bulletin 63, pp. 24-25, December, 1994

Recent developments in wireless hearing aid technology by ReSound utilize the 5.850-5.875 GHz band to overcome these impediments. These advancements allow electronic enhancement of audio signals in a compact processor system, that can be worn by the user at a location remote from the earpiece (e.g., on the user's belt). The processor system communicates with the earpiece via radio waves. By concentrating the signal enhancement hardware in the remote processing unit, the separate earpiece can be made sufficiently small as to be invisible to the casual observer, and a quarter-wavelength one-half-inch antenna can be disguised as an ear hair.[11/] Miniaturization of components within the device allow it to be worn unobtrusively and without stigma. Furthermore, the quality of the hearing device and advanced features necessary for highly impaired users now are possible when operated in accordance with existing Commission rules for the 5.850-5.875 GHz band. Based on these factors, ReSound urges the Commission to exclude the Quiet Band from the NII/SUPERNet allocation, as set forth in greater detail below.

[11/] Although wireless hearing aids can be made that operate in the "auditory assistance device" frequency bands near 73 MHz (see 47 C.F.R. § 15.237), hearing aids operating in lower spectrum bands, including the 2.4 GHz band, cannot benefit from miniaturization, resulting in large components and unacceptably cumbersome and visible earpieces.

B. Federal Telecommunications Policy Must Safeguard the Interests of Hearing-Impaired Individuals

10. The Commission has in the past been sensitive to the issue of interference to hearing aid devices.[12/] Recently, the Commission reiterated its intent to consider the interests of disabled Americans when implementing federal telecommunications policy. In a speech last month to the annual convention of Self-Help for Hard of Hearing People, Inc. ("SHHH"), the Chief of the Wireless Telecommunications Bureau outlined the substantive issues before the Commission that particularly affect the hearing-disabled population and stressed the Commission's commitment to serving the needs of that population.[13/] One issue is interference between cellular telephones and hearing aids, which has been a source of considerable controversy and now is the subject of a pending proceeding. Failure to take adequate notice of the potential for interference to hearing aids in the Quiet Band would likely lead to a similar controversy. ReSound believes that the contentiousness that has marked the cellular/hearing aids debate can and should be avoided in this proceeding.

[12/] See Revision of Part 15 of the Commission's Rules Regarding the Operation of Radio Frequency Devices without an Official License, 5 FCC Rcd 7729 (1990), where the Commission granted in part a petition for reconsideration filed by hearing aid manufacturers seeking to reduce possible interference from low power AM radio systems.

[13/] "Making Full Access a Reality: A Practical Perspective on Translating Vision Into Action," June 21, 1996.

11. The Commission also has statutory obligations to fulfill with respect to the hearing impaired. The Americans with Disabilities Act requires all agencies of the federal government to address barriers to communications faced by all people with disabilities.[14/] The Commission has embraced these obligations;[15/] indeed, the importance of these efforts is highlighted by the fact that the Chairman of the Commission created the Disabilities Issues Task Force, and appointed himself to head it.

12. According to the NPRM, unlicensed NII/SUPERNet devices are targeted for use in schools, libraries, government facilities, and businesses[16/] -- the same locations frequented by many active hearing-impaired individuals.[17/] While the NII/SUPERNet devices undeniably will offer numerous benefits to the public, the uses of such devices are, at present, speculative. Hearing aids, by contrast, have widely-recognized benefits and have long served the public interest. ReSound urges the Commission

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[14/] 42 U.S.C. § 12101.

[15/] For example, Chairman Hundt recently stated that the goals of the Telecommunications Act of 1996 are consistent with those of the Americans with Disabilities Act. FCC Open Meeting, June 27, 1996.

[16/] NPRM, para. 33.

[17/] For example, most schools now provide accommodations for hearing impaired children in regular classrooms, and libraries are favorite destinations for retired and elderly persons.

not to overlook the interests of the hearing-disabled as it pursues the worthy goals that may be achieved by a ubiquitous NII/SUPERNet network.

III. ISM Devices Must Be Protected from Harmful Interference

13. The NPRM proposes to limit the peak EIRP for NII/SUPERNet devices to -10 dBW (0.1 watt), but also seeks comment on whether to allow operation at up to 1 watt of transmitter output power in the 5.725-5.875 ISM band.[18] According to the Commission, operations at 0.1 watt will permit communications at distances of up to 100 meters and thus will achieve most of the benefits of the community networks advanced by Apple and WINForum.[19] The NPRM also states that NII/SUPERNet devices must not cause harmful interference to incumbent operations in the bands proposed for NII/SUPERNet use.[20]

14. As set forth below, the results of ReSound's technical analysis of the proposed NII/SUPERNet allocation indicate that sharing between NII/SUPERNet devices and ISM equipment is possible, provided that (1) NII/SUPERNet devices are not permitted to operate in the 5.850-5.875 GHz band; (2) ISM equipment continues to be accorded primary

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[18] NPRM, paras. 47, 48.

[19] NPRM, para. 47.

[20] NPRM, para. 46.

status in the 5.725-5.875 GHz band; and (3) NII/SUPERNet devices are limited to 100 milliwatts peak EIRP, as proposed.

A. Harmful Interference Will Result to ISM Operations in the Quiet Band Under the Commission's Proposal

15. The NPRM tentatively concludes that with "appropriate technical constraints" NII/SUPERNet devices can share the 5.725-5.875 GHz band with existing amateur, unlicensed, and ISM operations.[21/] The NPRM proposes a spectrum sharing protocol of "listen before talk". Specifically, unlicensed devices would be required to monitor the frequencies on which they intend to transmit in order to determine if the frequency availability; to limit the maximum time unlicensed devices may transmit to 10 milliseconds; and to require unlicensed devices to wait 50 microseconds after ceasing transmission before beginning to monitor again.[22/]

16. ReSound's technical analysis of the proposal set forth in the NPRM, contained in Exhibit 1 hereto, concludes that devices permitted to operate in the Quiet Band would be rendered inoperable by NII/SUPERNet devices operating in the band under the listen-before-talk protocol. Wireless hearing aids in the 5.850-5.875 GHz band comply

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[21/] NPRM, para. 35.

[22/] NPRM, para. 52.

with Section 15.249 of the Commission's rules for low-power unlicensed transmitters, and are not subject to shared use by spread spectrum transmitters of the type permitted by Section 15.247 of the rules.[23/]

17. Adoption of the proposed listen-before-talk protocol would fail to prevent harmful interference to present equipment operating in the 5.850-5.875 GHz band under Section 15.249. NII/SUPERNet equipment conforming to the spectrum etiquette cannot detect the presence of a Section 15.249 transmitter unless it is within 30 feet of that transmitter. Beyond 30 feet, NII/SUPERNet equipment conforming to the listen-before-talk protocol proceeds to transmit, causing harmful interference to any Section 15.249 receiver within 2.5 miles. Physical separation of the interfering equipment and signals does not resolve the problem of interference between hearing aid products and NII/SUPERNet devices.

18. ReSound also suggests an alternative to the etiquette proposal contained in the NPRM. To minimize potential interference to adjacent bands, ReSound proposes that for systems of less than 25 MHz emission bandwidth, rather than starting the search for an available spectrum window from the outside of the band, the search should start

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[23/] Because of size constraints imposed by the human ear canal, operation of wireless hearing aids in the same band as spread spectrum transmitters is impractical.

from the inside of the band. Thus, ReSound recommends replacing the language of proposed rule section 15.411(c) with the following language:

> All systems of more than 25 MHz emission bandwidth will first occupy the center half of the band, while systems of less than 25 MHz emission bandwidth shall start searching the remaining spectrum for a window proceeding from the innermost available frequencies to within 30 MHz of the band edge at 5150, 5350, 5725, or 5850 MHz.

B. ISM Devices Should Continue to Enjoy Primary Status

19. The NPRM acknowledges that "the low power (0.1 watt) NII/SUPERNet devices ... would operate at a higher power (approximately 21 dB EIRP higher) than existing non-spread spectrum Part 15 intentional radiators permitted in the 5.725-5.875 GHz band,"[24] but fails to explain how this can occur without interference. The NPRM does state, however, that it is the intent of the Commission to adopt rules that "ensure that [NII/SUPERNet] devices do not cause harmful interference to the incumbent and proposed operations in these or adjacent bands."[25] The inconsistency between these statements must be resolved in favor of interference-free operations. There should be no

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[24] NPRM, para. 47.

[25] NPRM, para. 46.

modification of the interference protection that ISM devices receive under the Commission's existing rules.[26/]

20. The NPRM mistakenly suggests that all of the 5.725-5.875 GHz band is subject to potential interference from Part 15 spread spectrum devices operating at 1 watt peak EIRP.[27/] In fact, this is true only with respect to the 5.725-5.850 GHz band -- not the Quiet Band. Thus, in order to continue existing interference protection standards for ISM operations in the Quiet Band, NII/SUPERNet operations should not be permitted therein.[28/]

IV. The Apple and WINForum Proposals Can Be Accommodated with Minor Modifications

21. ReSound believes that an acceptable solution to the problem of interference to hearing aids caused by NII/SUPERNet devices is readily at hand. By eliminating the Quiet Band from the NII/SUPERNet allocation, the Commission can accommodate the Apple and WINForum proposals without harming users and manufacturers of ISM band equipment.

22. As noted, WINForum's original vision of SUPERNet foresaw a need for only 250 MHz of spectrum, at 5.10-5.35 GHz. For its part, Apple requested an allocation

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[26/] See 47 C.F.R. §§ 15.247, 15.249.

[27/] NPRM, para. 48.

[28/] NII/SUPERNet operations at 1 watt in the 5.725-5.850, if permitted, should be consistent with existing rule Section 15.247, including according primary status to ISM devices.

of only 300 MHz of spectrum, at 5.15-5.30 GHz and 5.725-5.875 GHz. Yet the NPRM, without explanation, proposes to allocate 350 MHz of spectrum for NII/SUPERNet devices -- more than was requested by either Apple or WINForum in their respective petitions for rulemaking. This appears unnecessary in view of the complimentary nature of the Apple and WINForum proposals.

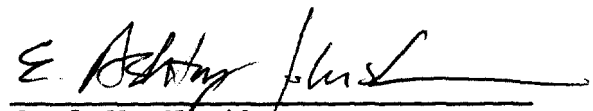
23. There appears to ReSound to be an insufficient record on which to base an allocation of 350 MHz for NII/SUPERNet at this time, and the Commission may decide to scale back significantly its proposal upon reviewing the comments received in this docket. In any event, in determining what amount of spectrum will be adequate to implement NII/SUPERNet, the Commission should take into account the competing needs of hearing aid users and manufacturers, as well as other users of Section 15.249 equipment. These needs can be accommodated simply by allocating to NII/SUPERNet operations the 300 MHz originally requested by Apple. This results in an allocation that would include only the 5.725-5.825 GHz portion of the ISM band, rather than the entire 5.725-5.875 GHz band. This is particularly appropriate in light of the fact that there is no request, and no record justification, for allocating more than 300 MHz for NII/SUPERNet operations at this time.

V. Conclusion

WHEREFORE, the foregoing premises duly considered, it is respectfully requested that the Commission adopt rules in this proceeding that are consistent with the foregoing comments of ReSound Corporation.

Respectfully submitted,

RESOUND CORPORATION

By: 

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July 11, 1996

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EXHIBIT 1

Technical Statement of ReSound Corporation

Prospects for Interference to Permissible Operations in the 5.850-5.875 GHz Band Caused by Unlicensed NII/SUPERNet Operations

I. Executive Summary

It is shown that the listen-before-talk protocol proposed in ET Docket No. 96-102 fails to prevent harmful interference to ISM devices in the 5.850-5.875 GHz band. The recommended solution is to avoid the use of the 5.850-5.875 GHz band for unlicensed high-speed wireless digital devices as proposed.

II. Background

Traditional hearing instruments have certain well-known drawbacks. For example, when used for listening to stereo and commercial sources of audio programming, such as broadcast television and radio, an omni-directional microphone causes other environmental sounds to mix with and obscure perception of the audio sound. The traditional solution is to connect the audio source electronically to the hearing aid with a cable; this is called Direct Audio Input or DAI. It has been demonstrated that a wireless connection would produce enhanced user benefit.

Wireless reception in and transmission from a hearing instrument presents a set of exceptionally challenging design constraints, especially in the emerging Completely-in-the-Canal ("CIC") devices. These devices severely limit the size, space, weight, and power available. First, to meet this challenge, a wireless system must have high antenna efficiency to minimize RF power requirements. The 5 GHz band presents this optimization; e.g., 1/4 wavelength antennae are about 1/2" in length. For reasons of packaging, comfort, and stigma, however, longer antennae at lower frequencies are not a viable option. On the other hand, commercial integrated circuits and low DC power parts are not available at higher frequencies. Second, size,

power, and real-time limitations eliminate the ability to perform the "listen-before-talk" etiquette proposed in ET Docket No. 96-102 using any current or emerging technology. By their nature, hearing instruments cannot be complex devices. Unchanged, the current 5 GHz ISM band rules present an opportunity to enhance the quality of life for hearing challenged citizens.

Non-licensed communications systems operating under section 15.249 of the Commission's Rules may presently use the 5.850-5.875 GHz "Quiet Band" to avoid interference from transmitters that operate under rule section 15.247. See OET Bulletin 63, pp. 24-25, December, 1994. The 25 MHz of spectrum in the Quiet Band is adequate to transmit data for applications such as wireless home audio compact disc players that require a data rate of 2.1169 Mbps and low data error probability. Equipment that conforms to the proposed FCC rule uses a listen-before-talk protocol that fails to prevent harmful interference to present section 15.249 equipment in the 5.850-5.875 GHz band. An example is given in which equipment conforming to the proposed rule does not detect the presence of a section 15.249 transmitter unless it is within 30 feet of said transmitter. Beyond that range, the equipment conforming to the proposed rule then proceeds to transmit, and causes harmful interference to any section 15.249 receiver within 2.5 miles.

III. Existing Equipment

Existing equipment that operates under section 15.249 may use a continuously-transmitting phase-shift keying (PSK) signal with an average power level of 0.75 mW (-1.25 dBm) and an isotropic antenna. Such equipment has a 6 dB bandwidth of twice the data rate and a 19 dB bandwidth of five times the data rate. A data rate of 5 Mbps can easily be supported in the 5.850-5.875 GHz band. Thermal noise power in the 25 MHz bandwidth is -100 dBm. A 14 dB SNR yields a bit error probability of one millionth, or one error every 200 msec at a 5 Mbps rate. Such an error rate is considered to be acceptable

when digital error detection and correction techniques are used, but higher error rates are considered unacceptable. Under these conditions, the minimum usable level at the receiver is -86 dBm, which occurs at a range of 230 feet. Range is limited by the free space path loss, expressed in dB as 96.58 +20[log(range in miles x frequency in GHz)]; i.e., -86 = -1.25 - 96.58 - 20[log(0.0436 x 5.8625)].

IV. Proposed Equipment

Equipment built to the proposed NII/SUPERNet rule would have a monitoring threshold 32 dB above the noise floor, or -100 + 32 = -68 dBm. With such a threshold, the proposed equipment can only detect an existing section 15.249 transmitter if it is within a 30-foot range. Failing to detect any transmitter, the proposed equipment would proceed to transmit at a 100 mW (+20 dBm) level in a manner that is essentially continuous, as no section 15.249 transmitter would be detected in the brief listening intervals. The proposed transmitter then causes harmful interference as it raises the noise floor and data error rate of any existing section 15.249 receiver within a range of 2.5 miles.

V. Solution

The recommended solution is to not allow the use of the proposed equipment in the 5.850-5.875 GHz band.